Active Project (2016 - 2018)

A Distributed Resilient Autonomous Framework for Manned/Unmanned Trajectory-Based Operations, Phase II Project

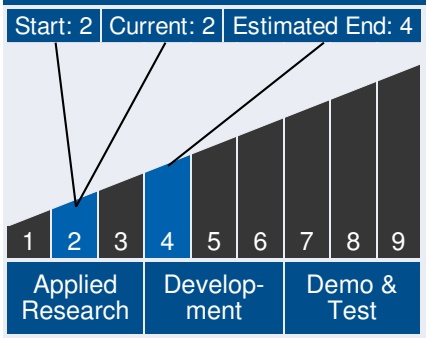
SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Resilient Ops, working in collaboration with Metron Aviation, Inc., proposes to develop a prototype system for planning Unmanned Aircraft Systems (UAS) trajectories based on user intent and preference information. The system, called DRIFT-UAS (Distributed Resilient Framework for Trajectory Management of Unmanned Aircraft Systems), is intended to support autonomous Air Traffic Flow Management (ATFM) under Trajectory-Based Operations (TBO). It is composed of algorithms and information-sharing components that enable autonomous trajectory planning while optimizing system-wide objectives such as safety, efficiency, and equity. DRIFT-UAS works for a mixed environment (manned and unmanned aircraft), but special emphasis is placed on Unmanned Aircraft Systems (UAS). The immediate application is primarily targeted at lower-altitude aircraft (below 18,000 feet) but DRIFT-UAS would apply as well to upper altitudes. Using DRIFT-UAS, flight operators and air traffic management iteratively exchange trajectory intent and congestion feedback to develop trajectories that are efficient and equitable, while preserving an aircraft's autonomy in generating its own trajectories based on its internal objective tradeoffs. The feedback aspect of the DRIFT-UAS architecture separates it from other "evaluators," i.e., systems that check whether operating constraints are violated given a set of trajectories. Once DRIFT-UAS checks the proposed trajectories against system constraints, it provides each aircraft with information via a price update on levels of congestion and system constraints in space and time that would enable the aircraft to revise its trajectory if required. This two-way communication between aircraft and air traffic management on trajectory intent and feasibility results in better trajectories as well as clearer guidance to airspace users as to which trajectories are most likely to be available.

Table of Contents

Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Continued on following page.

A Distributed Resilient Autonomous Framework for Manned/Unmanned Trajectory-Based Operations, Phase II Project

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: The core application of the work in this project will be to further NASA's and the FAA's goals to enable safe and efficient Trajectory-Based Operations for UAS. If successful, it is envisioned that DRIFT-UAS will provide the platform though which all aircraft (unmanned or otherwise) would strategically interact with the air traffic management system to signal trajectory intent and receive feedback on delays and congestion. DRIFT-UAS would also serve as a centralized repository for trajectory intent and system capacity. In the short-term, DRIFT UAS could be integrated within NASA's SMART NAS platform as a trajectory planning module. This would aid SMART NAS in technology demonstrations and research experiments for topics such as integrating UAS into the national airspace system, planning traffic flow management activities, collaborative decision making for traffic flow management, trajectory-based operations, and enabling civilian low-altitude airspace UAS Operations. Near-term applications of DRIFT-UAS include estimating the impact of late entrants (i.e. unmanned or manned pop-up flights) to the system by examining the marginal cost of their addition, and measuring the marginal cost of all aircraft in the system to devise more efficient allocation schemes.

To the commercial space industry:

Potential Non-NASA Commercial Applications: The FAA will have similar interest in DRIFT-UAS as would NASA, by providing a prototype tool for planning trajectories based on user intent and preference information. If DRIFT-UAS were to go live, the FAA would be the holder of the software. Like NASA, the FAA will have interest in conducting research experiments for UAS integration and trajectory-based operations. These simulation and experimental needs are shared by other non-NASA organizations, especially those who possess or are developing

Management Team *(cont.)*

Program Manager:
- Carlos Torrez

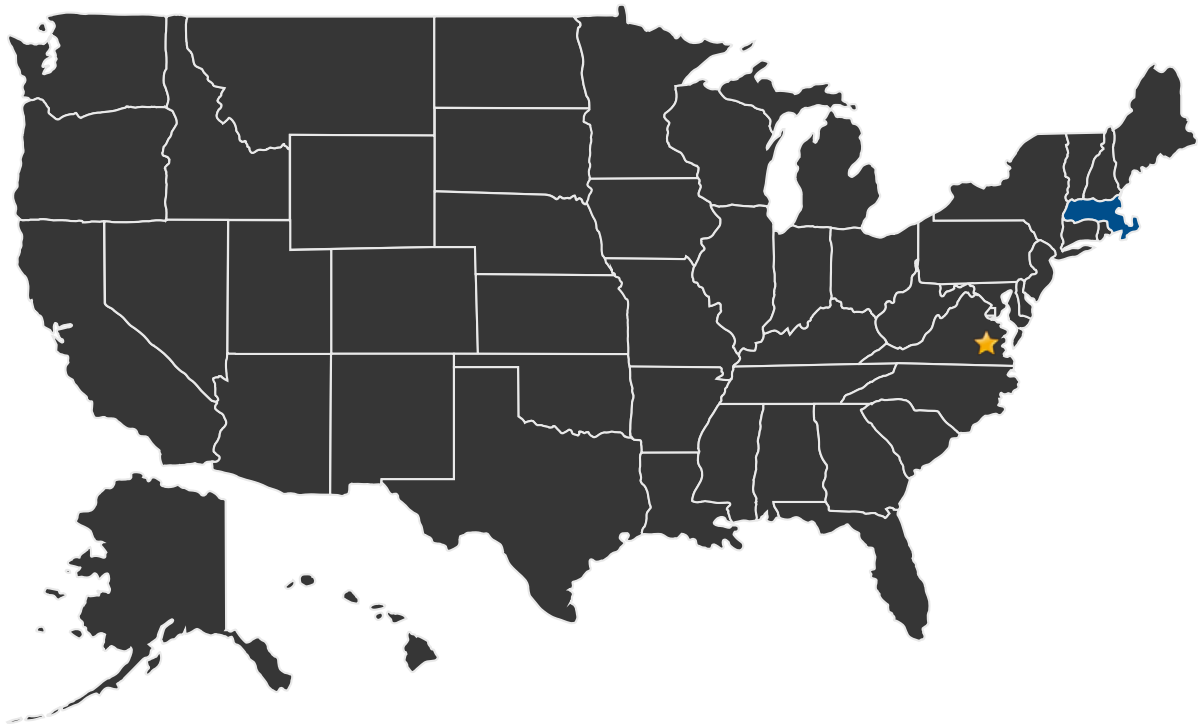
Principal Investigator:
- Bala Chandran

Technology Areas

Primary Technology Area:
Communications, Navigation, and Orbital Debris Tracking and Characterization Systems (TA 5)
└ Integrated Technologies (TA 5.5)

large-scale air transportation simulators. Those organizations include Embry Riddle University, MITRE-CAASD, and Volpe. Each of these organizations has a European counterpart with comparable roles and interests. Those organizations include EUROCONTROL, SESAR, and the Ecole Polytechnique. Furthermore, for real-time application of DRIFT-UAS, there are many foreign air navigation service provides (ANSP), who are the counterpart of the FAA, with burgeoning air traffic management systems that could benefit from more organized methods of trajectory planning. In some respects, these are even more viable customers for our product than the FAA because their air traffic management systems are less highly developed (in some cases, nascent) and, therefore, able to incorporate new subsystems. Countries with such ANSP include South Africa, the Dominican Republic, Australia, and Colombia.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Langley Research Center

Other Organizations Performing Work:

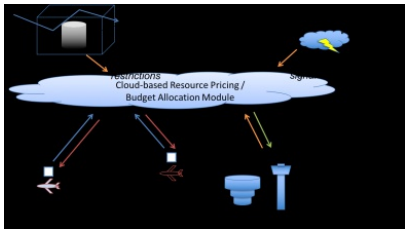
- Resilient Ops, Inc (Winchester, MA)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23547)

IMAGE GALLERY



A Distributed Resilient Autonomous Framework for Manned/Unmanned Trajectory-Based Operations, Phase II

DETAILS FOR TECHNOLOGY 1

Technology Title

A Distributed Resilient Autonomous Framework for Manned/Unmanned Trajectory-Based Operations, Phase II

Potential Applications

The core application of the work in this project will be to further NASA's and the FAA's goals to enable safe and efficient Trajectory-Based Operations for UAS. If successful, it is envisioned that DRIFT-UAS will provide the platform though which all aircraft (unmanned or otherwise) would strategically interact with the air traffic management system to signal trajectory intent and receive feedback on delays and congestion. DRIFT-UAS would also serve as a centralized repository for trajectory intent and system capacity. In the short-term, DRIFT UAS could be integrated within NASA's SMART NAS platform as a trajectory planning module. This would aid SMART NAS in technology demonstrations and research experiments for topics such as integrating UAS into the

national airspace system, planning traffic flow management activities, collaborative decision making for traffic flow management, trajectory-based operations, and enabling civilian low-altitude airspace UAS Operations. Near-term applications of DRIFT-UAS include estimating the impact of late entrants (i.e. unmanned or manned pop-up flights) to the system by examining the marginal cost of their addition, and measuring the marginal cost of all aircraft in the system to devise more efficient allocation schemes.